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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/720,962	11/24/2003	Stuart Stephen Papworth Parkin	ARC920030058US1	5214

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EXAMINER	
NGUYEN, JOSEPH H	

ART UNIT	PAPER NUMBER
2815	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/720,962	PARKIN ET AL.	
	Examiner	Art Unit	
	Joseph Nguyen	2815	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *14 March 2007*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-35 and 51-55* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-35 and 51-55* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *24 November 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *3/14/07*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 03/14/2007 has been entered.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

The changes made to 35 U.S.C. 102(e) by the American Inventors Protection Act of 1999 (AIPA) and the Intellectual Property and High Technology Technical Amendments Act of 2002 do not apply when the reference is a U.S. patent resulting directly or indirectly from an international application filed before November 29, 2000. Therefore, the prior art date of the reference is determined under 35 U.S.C. 102(e) prior to the amendment by the AIPA (pre-AIPA 35 U.S.C. 102(e)).

Claims 1-3, 7, 10-16, 22-26, 51 and 54 are rejected under 35 U.S.C. 102(e) as being anticipated by Odagawa et al. (US Publication No. 2004/0052006).

Regarding claim 1, Odagawa et al. discloses in figure 23A a magnetic tunnel element comprising a first layer 210 formed from am amorphous material (paragraph [0193])); an amorphous tunnel barrier layer 120 (the tunnel barrier layer formed of an oxide of Al which is amorphous in paragraph [0209]); and an interface layer 220 between and in proximity with the first layer and the tunnel barrier layer, the interface layer being formed from at least one material selected from the group consisting of ferromagnetic material (paragraph [0193]).

It is noted that the phrase "wherein the interface layer material is crystalline wherein it is in isolation from both the first layer and the tunnel barrier layer" is merely the process limitation. The interface layer 220 is formed of Co-Fe alloy, which is the same material being used in the instant application (page 5, lines 35-39 of the instant application) such that the interface layer is inherently crystalline when in isolation from both the first layer and the tunnel barrier layer.

Regarding claim 2, Odagawa et al. teaches the first layer 210 is formed of CoFeB, which is amorphous ferromagnetic material (paragraph [0193]).

Regarding claim 3, Odagawa et al. discloses in figure 23A a second layer 110 in contact with the tunnel barrier layer 120 and including at least one material selected from the group consisting of ferromagnetic material (paragraph [0102]). Since layer 110 contains Fe, it is ferromagnetic.

Regarding claim 7, the claim language is merely functional language. The interface layer 220 constitutes a similar structure and material as the claimed interface layer and therefore can be configured to perform the claimed function.

Regarding claims 10-11, Odagawa et al. discloses the interface layer 220 includes at least a Fe containing alloy, which includes Co (paragraph [0194]).

Regarding claim 12, Odagawa et al. teaches in paragraph [0194] the CoFe alloy has an atomic percent Fe being 0.0 and 50, which has its upper limit in the claimed range of 10% to 95%.

Regarding claim 13, Odagawa et al. teaches the Fe containing alloy includes Ni (paragraph [0194]).

Regarding claim 14, Odagawa et al. teaches the Fe containing alloy is formed from Fe and at least one of Co and Ni (paragraph [0194]).

Regarding claim 15, Odagawa et al. teaches the tunnel barrier layer 120 includes an oxide of Al (paragraph [0209]).

Regarding claim 16, Odagawa et al. teaches the first layer 210 includes an alloy of Co, Fe and B (paragraph [0193]).

Regarding claim 22, Odagawa et al. teaches the thickness of the interface layer 220 is 2 nm or less, which is less than 30A (paragraph [0196]).

Regarding claim 23, Odagawa et al. teaches the thickness of the interface layer 220 is less than 2nm, which is also less than 20A (paragraph [0196]).

Regarding claim 24, Odagawa et al. teaches the thickness of the interface layer is so thin (less than 2nm). Therefore, when in contact with the tunnel barrier layer and

the first layer, the interface layer will become amorphous in the same manner as taught by applicant (page 20, lines 19-25 of the instant application).

Regarding claim 25, similar to claims 1 and 24 above, Odagawa et al. discloses in figure 23A a magnetic tunnel element comprising a first layer 210 formed from an amorphous material; an amorphous tunnel barrier layer 120; and an interface layer 220 being formed from at least one material selected from the group consisting of ferromagnetic materials wherein the interface layer material is crystalline when it is in isolation from both the first layer and the tunnel barrier layer the thickness of the interface being selected so that the interface layer is amorphous, which is not crystalline.

Regarding claim 26, Odagawa et al. teaches that the first layer 210 is formed from at least one material selected from the group consisting of amorphous ferromagnetic materials (paragraph [0193]).

Regarding claims 51 and 54, Odagawa et al. teaches the interface layer 220 is the alloy of Ni-Co-Fe (paragraph [0194]), which clearly comprises no glass forming elements.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 4-6 are rejected under 35 U.S.C. 102(e) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Odagawa et al.

Regarding claims 4-6, since Odagawa et al. teaches a similar structure and material as claimed, it is inherent that the magnetic tunnel junction of Odagawa et al. has a tunneling magnetoresistance (TMR) greater than 50%, 60% and 65% as claimed. However, in the alternative, if the magnetic tunnel junction of Odagawa et al. includes a tunneling magnetoresistance (TMR) at a certain value, but not necessarily greater than 50%, 60% and 65% as claimed, the Examiner takes the Official Notice that it would have been obvious to one of ordinary skill in the art the time of the present invention to modify the magnetic tunnel junction of Odagawa et al. to achieve the tunneling magnetoresistance (TMR) greater than 50%, 60% and 65%, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980). Also See MPEP 2112 (Revision 5, August 2006), page 2100-47 for the Requirement of Rejection based on Inherency under 35 U.S.C 102/103.

Claims 8-9 and 52-53 are rejected under 35 U.S.C. 103(a) as being unpatentable over Odagawa et al. in view of Hayakawa (US Patent No. 6,754,100).

Regarding claim 8, Odagawa et al. discloses in figure 23A a metal containing layer 110 in contact with the tunnel barrier layer 120. Odagawa et al. does not disclose a semiconductor layer is in contact with the first layer. However, Hayakawa discloses

in figure 8 the magnetic tunnel element comprising a semiconductor layer 13 is in contact with the first layer 31 to perform the spin injection and thus to supply the tunnel magnetoresistive device 3 with current having larger spin polarization, increasing magnetoresistance ratio (column 8, lines 32-47). In view of such teaching, it would have been obvious at the time of the present invention to modify Odagawa et al. by including a semiconductor layer in contact with the first layer to supply the tunnel magnetoresistive device with current having larger spin polarization, increasing magnetoresistance ratio.

It is noted that the combination of Odagawa et al. and Hayagawa et al. would include the metal containing layer, the tunnel barrier, the interface layer, the first layer and the semiconductor layer that together inherently forms a magnetic tunneling transistor herein.

Regarding claim 52, Hayakawa et al. teaches the current passing from the first layer 31 to the semiconductor layer 13 comprises spin polarized current (column 8, lines 32-47).

Regarding claim 9, Odagawa et al. discloses in figure 23A substantially all the structure set forth in claim 9 except a semiconductor material layer in proximity with the tunnel barrier layer. However, Hayakawa discloses in figure 9 the magnetic tunnel element comprising a semiconductor layer 13 is in proximity with the tunnel barrier layer 22 to supply the tunnel magnetoresistive device 3 with current having larger spin polarization, increasing magnetoresistance ratio (column 8, lines 32-47). In view of such teaching, it would have been obvious at the time of the present invention to

modify Odagawa et al. by including a semiconductor layer in proximity with the magnetic tunnel layer to supply the tunnel magnetoresistive device with current having larger spin polarization, increasing magnetoresistance ratio.

It is noted that the combination of Odagawa et al. and Hayagawa et al. would include the semiconductor layer, the tunnel barrier, the interface layer, the interface and the first layer that together inherently forms a spin injector herein.

Regarding claim 53, Hayakawa et al. teaches the current passing from the first layer 31 to the semiconductor layer 13 comprises spin polarized current (column 8, lines 32-47).

Claims 17 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Odagawa et al. and Nishimura (US Patent No. 6,226,197).

Regarding claim 17, Odagawa et al. teaches of the alloy of CoFeB. Odagawa et al. does not teach $(Co_{70}Fe_{30})_{100-x}B_x$. Nishimura teaches the alloy of $(Co_xFe_{100-x})_{100-y}B_y$ wherein x is 80 or more and 96 or less, and y is 5 or more and 30 or less (column 14, lines 33-35). Nishimura does not teach x equals 70 as claimed. However, it would have been obvious at the time of the present invention to modify Odagawa et al. and Nishimura by having the alloy of $(Co_{70}Fe_{30})_{100-x}B_x$ for the purpose of increasing the capacity of the magnetic tunnel element, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Regarding claim 18, Nishimura teaches in column 14, lines 33-35 the value of y is 10 or more and 25 or less which covers the claimed range of 15 to 20.

Claims 19-21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Odagawa et al. in view of Saito et al. (US Patent No. 6,556,473).

Regarding claim 19, Odagawa et al. teaches the first layer 210 is the alloy of Co, Fe, B (paragraph [0193). Odagawa et al. does not teach the first layer is the alloy of Co, Fe, X and Y wherein in X and Y are independent and chosen from the group consisting of B, Hf, Zr, C, Be, Si, Ge, P and Al. However, Saito et al. teaches the ferromagnetic layer can be the alloy of Co, Fe, Si and B (column 16, lines 25-44, Table 1). In view of such teaching, it would have been obvious at the time of the present invention to modify Odagawa et al. by having the first layer being the alloy of Co, Fe, Si and B to obtain a lower current and thus reduce the writing power consumption in the magnetic memory as taught by Saito et al (column 16, lines 49-51).

Regarding claim 20, it is inherent that when crystalline Co-Fe is added with a certain amount of B and Hf, the alloy would be caused to be amorphous.

Regarding claim 21, Odagawa et al. teaches the first layer is the alloy of Co, Fe and B (paragraph [0193]). Odagawa et al. does not teach the first layer is the alloy of Co, Fe and Zr. However, Saito et al. teaches the ferromagnetic layer can be the alloy of Co, Fe and Zr (column 9, lines 27-31). In view of such teaching, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Odagawa et al. by having the first layer being the alloy of Co, Fe and Zr to obtain a

small coercive force in a magnetic tunnel element as taught by Saito et al (column 9, lines 35-36).

Claims 27-35 and 55 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hosomi et al. (US Publication 2004/0136232) in view of Odagawa et al.

Regarding claim 27, Hosomi et al. discloses in figure 5a a memory device comprising a first plurality of conductive lines (WL); a second plurality of conductive lines (BL) overlapping the first plurality of conductive lines at a plurality of intersecting regions. Hosomi et al. further discloses in figure 5 the nonvolatile cell includes a magnetic tunnel element (1). However, Hosomi et al. does not disclose the magnetic tunnel element having the structure as claimed. Nevertheless, Odawaga et al. discloses in figure 23A the claimed structure of the magnetic tunnel element (See rejection of claim 1 above). In view of such teaching, it would have been obvious at the time of the present invention to modify Hosomi et al. by forming a memory device with the magnetic tunnel element disclosed by Odagawa et al. such that variations in the magnetoresistance properties in a fine patterned magnetoresistance element and a memory can be restricted (paragraph [0010], Odagawa et al.).

Regarding claim 28, Odagawa et al. teaches the first layer 210 is formed of CoFeB, which is amorphous ferromagnetic material (paragraph [0193]).

Regarding claim 29, Odagawa et al. discloses in figure 23A a second layer 110 in contact with the tunnel barrier layer 120 and including at least one material selected

from the group consisting of ferromagnetic material (paragraph [0102]). Since layer 110 contains Fe, it is ferromagnetic.

Regarding claims 30-32, since Odagawa et al. teaches a similar structure and material as claimed, it is inherent that the magnetic tunnel junction of Odagawa et al. has a tunneling magnetoresistance (TMR) greater than 50%, 60% and 65% as claimed. However, in the alternative, if the magnetic tunnel junction of Odagawa et al. includes a tunneling magnetoresistance (TMR) at a certain value, but not necessarily greater than 50%, 60% and 65% as claimed, the Examiner takes the Official Notice that it would have been obvious to one of ordinary skill in the art the time of the present invention to modify the magnetic tunnel junction of Odagawa et al. to achieve the tunneling magnetoresistance (TMR) greater than 50%, 60% and 65%, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980). Also See MPEP 2112 (Revision 5, August 2006), page 2100-47 for the Requirement of Rejection based on Inherency under 35 U.S.C 102/103.

Regarding claim 33, Odagawa et al. teaches the thickness of the interface layer 220 is 2 nm or less, which is less than 30A (paragraph [0196]).

Regarding claim 34, Odagawa et al. teaches the thickness of the interface layer 220 is less than 2nm, which is also less than 20A (paragraph [0196]).

Regarding claim 35, Odagawa et al. teaches the thickness of the interface layer is so thin (less than 2nm). Therefore, when in contact with the tunnel barrier layer and

the first layer, the interface layer will become amorphous in the same manner as taught by applicant (page 20, lines 19-25 of the instant application).

Regarding claim 55, Odagawa et al. teaches the interface layer 220 the alloy of Ni-Co-Fe (paragraph [0194]), which clearly comprises no glass forming elements.

Response to Arguments

Applicant's arguments with respect to claims 1-35 and 51-55 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Joseph Nguyen whose telephone number is (571) 272-1734. The examiner can normally be reached on Monday-Friday, 8:30 am- 5:00 pm. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ken Parker can be reached on (571) 272-2298. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300 for regular communications.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Joseph Nguyen

Patent Examiner

May 14, 2007.